IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Petri Jokela, et al.	§	Group Art Unit:	2431
		§		
Serial No:	10/599,761	§	Examiner:	Vaughan, Michael R.
		§		
Filed:	October 6, 2006	§	Confirmation No.:	3827
		§		

For: IDENTIFICATION METHOD AND APPARATUS FOR ESTABLISING HOST IDENTITY PROTOCOL (HIP) CONNECTIONS BETWEEN LEGACY AND HIP NODES

Via EFS-Web

Mail Stop AMENDMENT
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

CERTIFICATE OF MAILING OR TRANSMISSION

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450, or being transmitted via facsimile or EFS-Web to the USPTO on the date indicated below.

Date: March 9, 2010

Jennifer Hardin

Dear Sir:

AFFIDAVIT UNDER 37 C.F.R. § 1.131

I, Petri Aulis Jokela, hereby swear and state that:

1. I am the inventor of the subject matter of the above-referenced patent application.

2. I conceived of the subject matter of the above-referenced invention while working in my office in Finland prior to February 5, 2004, the publication date of the NPL Publication "Host Identity Protocol Rendezvous Mechanism" authored by Eggert, which was cited by the Examiner in rejecting claims 1-23, and 31 under 35 U.S.C. § 103(a) in the Office Action dated October 9, 2009.

3. The above-referenced patent application claims priority from PCT International Application Number PCT/EP2004/050533, filed on April 15, 2004.

3. I exhibited due diligence from prior to February 5, 2004, to the subsequent filing of the above-referenced PCT patent application.

4. Documentary evidence relating to the conception of my invention and my due diligence is provided in the following Exhibits:

Exhibit A: My original patent disclosure to the Patent Department at Ericsson AB (publ) (Ericsson) signed by me on November 24, 2003 (2003-11-24).

Exhibit B: An order letter dated March 23, 2004 from the Patent Department at Ericsson to outside patent counsel at Marks & Clerk requesting the drafting of a PCT patent application.

5. I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further, that these statements are made with the knowledge that willful false statements, and the like so made, are punishable by fine or imprisonment, or both, under Section 1001, Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: 9.2.2010

Petri Aulis Jokela

EXHIBIT A

ERICSSON in Finland

Easy-POP Invention Report

(Patent One Page)

Uppgjord (även faktaansvarig om annan) - *Prepared (also subject responsible if other)*		Nr - *No.*		
Dokansv Godk - *Doc respons/Approved*	Kontr - *Checked*	Datum - *Date*	Rev	File
		27.1.2004		LMF04002 (P19221)

TITLE: HIP Proxy in the GGSN

1 INVENTOR(S) + HOME ADDRESS(ES)

Petri Jokela, Jari Arkko, Pekka Nikander, Jukka Ylitalo, Patrik Salmela

☐ Separate registration form included

2 PROBLEM DESCRIPTION

Describe the problem that exists today and for which you shall propose a solution in the next chapter. Be brief, but write enough so that the persons analyzing this proposal get the right picture of the problem.

HIP Proxy in the GGSN. See below the full description of the problem and solution.

3 SOLUTION

Describe the technical solution to the problem presented in the previous chapter. This is where you should put the effort so that the persons analyzing the solution will understand it and get enough data for decision making.

→

4 DEADLINE

Inform when and where the idea will become public in a presentation or product or ETSI...

5 CRYSTALLIZATION

Write here the essential 'beef' or 'juju' of the solution in a couple of sentences.

6 BUSINESS VALUE

Name the product or standard, if any. Estimate the related business meaning of the solution.

Read and understood by: ..... Date: 28.1.2004

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		27.1.2004		LMF04002 P

FURTHER INFORMATION

ATTACH EMBEDDED FILES: INSERT -> OBJECT -> CREATE FROM FILE -> DISPLAY AS ICON -> BROWSE

TECHNICAL/BUSINESS OPINION BY _____

Date and signature of the opinioner, phone:

ERICSSON in Finland

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Dokansv Godk - *Doc respon/Approved*	Kontr - *Checked*	Datum - *Date*	Rev	File
		27.1.2004		LMF04002 P

INVENTOR REGISTRATION

Title of Invention	P-Number
Legacy host initiating communication towards a HIP host using a HIP proxy.	

INVENTORS

(Please underline a contact person for Patent Support, if nothing is mentioned we take the first inventor)

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Date	**Signature**	**Residential Country**	**Share in Invention %**
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		27.1.2004	LMF04002 P

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Date	Signature	Residential Country	Share in Invention %
		Finland	

Category/Type of invention according to inventor 1)

☐ A ☐ B ☐ C

Country

☒ **INVENTION DISCLOSURE**

1) Category/Type of invention is country-specific. The country in which an inventor is employed determines the category/type of invention. Please read the Inventor Registration Template Fill-In Instructions for selecting a category/type that fits to your invention.

Inventor Registration (IR) Template Fill-In Instructions for Category/Type of Invention

For specifying the category/type of invention, enter the country where you are employed in the "Country" field and tick one A,B,C according to the country-specific instructions given above

FINLAND

Category of invention applies to inventors employed by companies in **Finland** as follows

A-invention: Invention related to the inventors normal area work or special commission.

B-invention: Invention related to Ericsson's field of business, but not to the inventors normal area work or special commission.

C-invention: Invention that is neither A- or B-invention.

Uppgjord (även faktaansvarig om annan) - *Prepared (also subject responsible if other)*		Nr - *No.*		
Dokansv/Godk - *Doc respons/Approved*	Kontr - *Checked*	Datum - *Date*	Rev	File
		27.1.2004		LMF04002 P

OPINION PAGE

OPINIONER(S) AND DATE:_____

Technical Meaning:

Bussines Meaning:

HIP Proxy in the GGSN

1 General

To provide HIP support for nodes inside a 3G network, a proxy is required in the network. The natural place for a proxy is the GGSN. With proxy, advatages of HIP can be partly provided for legacy 3G terminals.

In Section 2, we describe the possible scenarios when HIP capable or legacy 3G UEs are communicating with either HIP capabel or legacy peer hosts. Section 3 goes deeper in required changes to the GGSN, required data to be maintained and changes to messaging.

2 Scenarios

The following scenarios can be identified when a 3G UE communicates with another host (peer host) in the external network.

2.1 Scenario 1

In Figure 1, the 3G legacy host is communicating with the peer HIP host. The GGSN takes part in the communication and protects the communication party between itself and the HIP peer node. The legacy host is unaware about the HIP negotiation and Security Association between the GGSN and the peer.

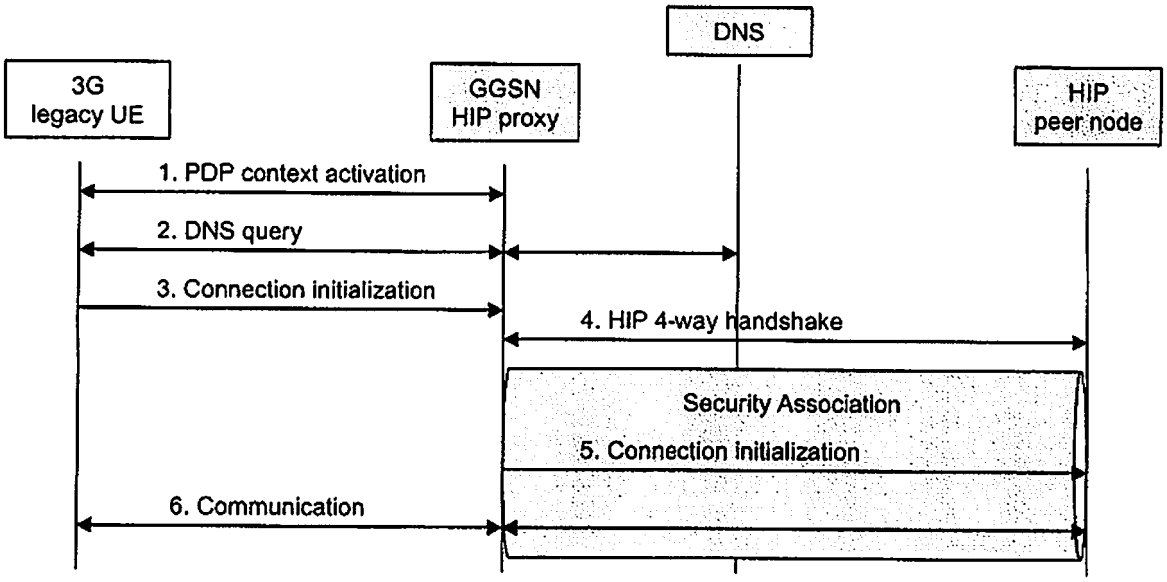

Figure 1 Scenario 1: 3G legacy UE and HIP peer node

1. The UE initiates the PDP context activation. The GGSN generates a key-pair (HI and secret key) and associates it with the UE, the key-pair is stored in the GGSN. Based on the public key (HI) a HIT is generated and sent to the UE as the address to be used. The UE gets the HIT and stores it as its address (HIT_{asIP}).

   In case of IPv4, the 3G terminal is assigned an LSI instead of the HIT. The requirement for the LSI is that it is unique inside the 3G network and the GGSN can identify the terminal from it. The terminal may experience problems when the assigned address (LSI) is used in protocols that include the host's address in the payload. This, however, is a general problem in IP networks when local addresses are used with such applications, e.g. FTP.

2. The UE wants to make a connection to the HIP peer node and sends out a DNS query to acquire the HIP peer node's address. The DNS query travels via the GGSN to the DNS. The DNS returns the HIP peer node's IP address (IP_{CN}) and HIT (if there is a HIT stored for it), HIT_{CN}. The GGSN gets the information from the DNS and stores the IP_{CN} and the HIT_{CN}. The HIT_{CN} is sent to the UE.

   If the UE is IPv4 only, the IP address that is sent to the UE must be IPv4 address. The GGSN must allocate an IPv4 address (or some other 32-bit representation for the peer node, we call it LSI_{peer}) if the DNS returned an IPv6 address only. The LSI_{peer} is unique inside the 3G network. The GGSN has the mapping between the HIP peer nodes HIT,

address for the HIP peer. Should the GGSN make an AAAA query so that it can receive an IPv6 address, and HIT, for the peer node and then return an LSI to the UE as a response to the type A query?)

3. The UE sends a connection initialization packet with destination set to the received HIP peer node's HIT (HIT_{CN}). The HIT (HIT_{asIP}) received in step 1 is used as source address.

   In case of IPv4, the destination address is the LSI allocated by the GGSN.

4. The GGSN notices that it has stored a HIT associated with the received packets destination HIT (or the assigned LSI in case of IPv4 UE) so it knows that it should use HIP. The GGSN can't find a Security Association for a connection between it and the HIP peer node so it performs the HIP 4-way handshake with the HIP peer node and creates SAs. It uses its own IP address and the HIT assigned to the UE during the handshake.

5. The GGSN sends the initialization packet, received from the UE in step 3, to the HIP peer node using the created SA. The package is sent with source address as the GGSN's IP address and HIT as the HIT assigned for the UE in step 1.

6. Communication continues; Between the GGSN and the HIP peer node the communication is protected with the HIP SA. When the GGSN receives a packet from the HIP peer node it processes it and sends the data as a regular IP packet to the UE based on the packets destination HIT which is the same that was assigned to the UE in step 1.

2.2 Scenario 2

Figure 2 shows the case when a HIP UE is communicating with a HIP capable peer node. The GGSN does not take part in the actual HIP negotiation, but it will gather information about the used HITs, IP addresses and SPIs. Because the internal IP address in the 3G network is not necessarily a globally unique address and not routable in the Internet, the GGSN must do address translation for packets flowing between the 3G network and the external network. The gathered information is used for enabling the required translation.

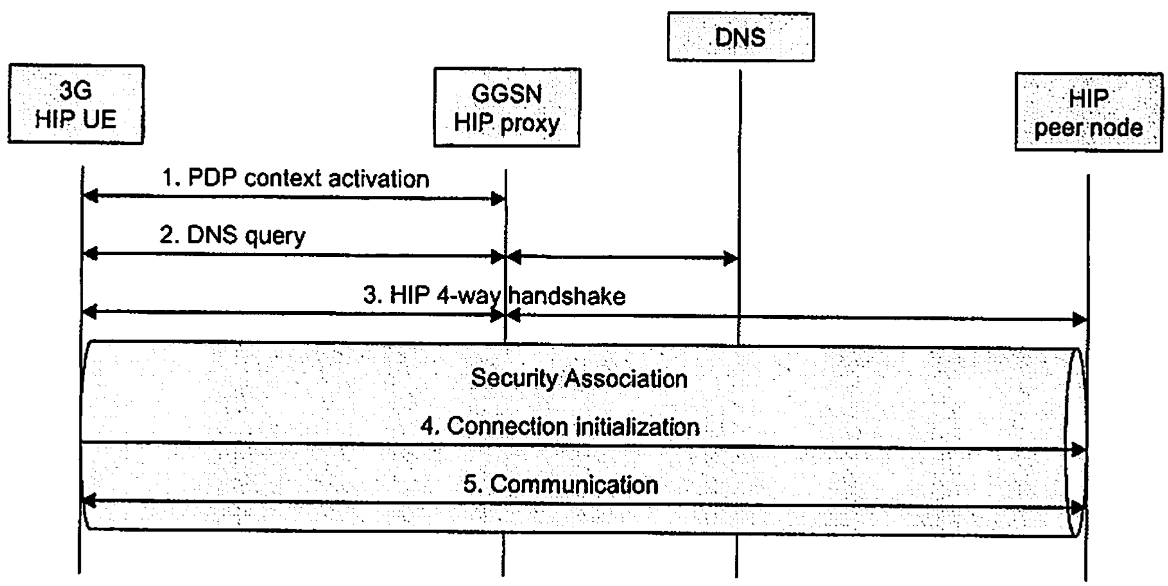

Figure 2 Scenario 2: 3G HIP UE and HIP peer node

1. PDP context activation: The 3G terminal makes PDP context activation with the GGSN. The HIP UE receives an IPv6 address from the GGSN (or a HIT? Does it matter?). The address is configured on the interface of the terminal. The address can be, but is not necessarily globally routable IP address.

   It is possible that the UE (or the network) is IPv4 only, thus IPv4 address may be required. (See Scenario 1, step 1).

2. UE starts a connection towards a HIP peer node. It makes a DNS query that is routed via the GGSN. The DNS response contains the HIT of the peer node and its IP address. The IP address may either point directly to the HIP peer or to a Forwarding Agent that is responsible for forwarding II packets to the correct destination. The GGSN retrieves the peer HIT and corresponding IP address from the DNS response.

   LSI usage in case of IPv4??? The host still can use IPv6 API and HITs even if it is not capable of sending IPv6 traffic in the network.

3. The 3G UE notices that the DNS

The GGNS notices that an I1 packet is passing by. If the source IP address is globally routable, it can pass the packet to the Internet. However, if the source address is not globally routable, it must make address translation between the local source address and an globally routable address. After the address translation, the packet is passed to the Internet.

The R1 packet arriving from the HIP peer, contains the IP address of the GGSN as the destination. The GGSN makes address translation and changes the destination address to the local address (unless the destination address is already globally routable and is going to the correct destination with that address).

The I2 packet sent by the terminal contains the SPI that will be used from the HIP peer towards the 3G UE. Thus, when the I2 packet passes by the GGSN, it picks the SPI value and maps it with the HIT and IP address of the 3G UE.

Similarily, when the R2 packet comes from the HIP peer, the SPI value is retrieved from the packet.

4. and 5. Traffic

Packets sent from the 3G terminal contain the HIP peer IP address as the destination, IP address of the terminal as the source and SPI given by the HIP peer node. When such a packet is received by the GGSN, the source IP address is replaced with an globally routable IP address. (SPI value is not needed..)

Packets destined to the 3G terminal are received by the GGSN containing the IP address of the GGSN as the destination, IP address of the HIP peer as the source and the SPI given by the 3G UE. The destination address conversion can now be made using the SPI and source IP address as the hint.

2.3 Scenario 3

The UE is HIP capable but it is trying to communicate with a legacy host in the Internet. During the DNS resolving process the GGSN (and the UE) learns that the peer node is not HIP capable, thus there is no need to try the HIP negotiation towards the peer host.

It is possible, in theory, that the UE and GGNS makes a HIP negotiation, but it is not relevat to one end-to-end connection. What is the point in having a security association between the UE and the GGSN (NOT at GTP level)? Mobility support, if there is WLAN hot-spots in the 3G network?

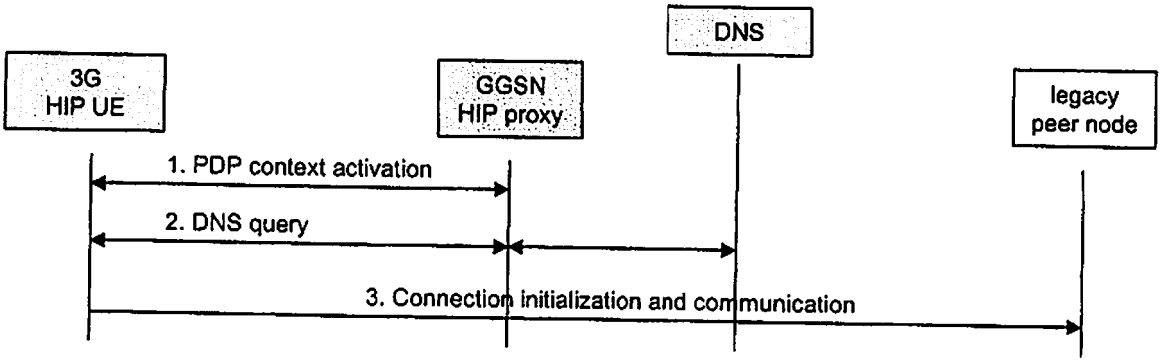

Figure 3 Scenario 3: 3G HIP UE and legacy peer node

2.4 Scenario 4

In this scenario, both of the communicating hosts (UE and the peer host) are legacy hosts. During the name resolution from the DNS, the GGSN notices that the peer host is not HIP capable as no HI information is returned.

During the PDP context activation, the 3G UE is assigned an HIT generated by the GGSN (HIT_{asIP}), or it is assigned an LSI (or similar) if the UE supports only v4.

When the UE resolves IP address for the peer node, and the DNS returns an IP address from a different address realm, the GGSN may generate a new address to represent the peer node. This new address is from the same IP address realm as the UE is using. Using this information, the GGSN acts as a IPv4-IPv6 protocol translator.

Figure 7 I1 packet: header information (only relevant information shown)

From this packet, the GGSN can see, which terminal has sent this packet (IP header, source address field). The GGSN makes address translation and replaces the source IP address to a globally routable IP address. The address may either directly point to the GGSN, or it is a reserved address for this UE that is routed to the GGSN from the external network (Figure 8).

Figure 8 I1 packet after GGSN address translation

Depending on the destination address, the packet is routed to the CN either directly or via CN's Forwarding Agent. The CN responds with an R1 packet. The packet contains headers as shown in Figure 9

Figure 9 R1 packet: header information

The GGSN receives the packet, verifies the correct recipient using the HIT_{UE} in the HIP header and retrieves the correct destination address. In this case the resulting packet headers will look like in Figure 10.

Figure 10 R1 packet: header information after address translation

I2 packet contains similar header information as the I1 packet. The packet contains also the SPI value selected by the UE. The SPI value is stored by the GGSN, thus forming a connection entry $\{HIT_{asIP}; SPI_{CN->UE}; HIT_{CN}\}$. This information is required for delivering the incoming data trafic to the correct UE.

From the R2 packet the GGSN can learn the SPI value that the UE will use towards the CN, but this information is not needed during the communication.

When the UE is HIP capable, the underlying address does not make much difference. Thus, the address conversion in the GGSN could be done if the assigned address is not HIT but some else 128-bit long string. The mapping of the address information still goes in a similar fashion. It can also be noted that the GGSN doesn't have to generate a key-pair to represent a HIP capable UE, the HIT-like bit pattern is enough.

3.4.2 HIP capable UE (v4 – v4 communication)

If the HIP UE (or the 3G network) is only v4 capable, the terminal may be assigned an IPv4 address. In case of HIP capable GGSN this means assigning the UE an LSI value.

3.4.3 Legacy UE (v4 – v4, v6 – v6, v4 – v6, v6 – v4)

XXX

3.4.4 SPI value information

The SPI value will be used to map the address information for incoming traffic. Thus, the value must be unique inside the 3G network and the UE cannot freely select the SPI value. There are two ways to solve the problem:

1) The SPI value is changed during the address translation.

This solution requires changes to the current HIP protocol. The SPI value in the I2 and R2 packets are protected by signatures and the GGSN cannot make the change as it cannot sign the packet. There are two possible solutions for this:

- The GGSN may be delegated the right to sign packets on behalf of the UE (*?????? can it be done like*

- The I2 and R2 packets are changed so that the SPI change is possible.

2) The GGSN allocates SPI range for the UE.

This would require some additional changes to PDP context activation. The SPI values could be reserved by the GGSN and transmitted to the UE during PDP context activation process. After this, the UE is allowed to use only these SPI values for communication. This might require some additional messages (or changes in further PDP context related messages) for managing the SPI range after the initial PDP context activation.

4 Open questions

- If the UE has resolved the HIT/IP address of the peer already earlier and the GGSN does not have any cached information about the peer HIT etc. How does it work then? In scenario 1) the UE initializes the connection, and the GGSN just lets the packet pass as it does not know the HIT. (Reverse lookup using the IP address? Does not work, there may be more than one corresponding hosts using the same IP address, in case of IP address is mapped to a Forwarding Agent). In scenario 2) the UE sends I1, from where the GGSN starts learning information.

POSSIBLE CLAIMS

1) HIP Proxy in the GGSN
2) GGSN generating keys for UEs
3) GGSN assigning HITs/LSIs for UEs
4) GGSN sending HITs/LSIs for UEs
5) GGSN mapping SPIs to local IP addresses
6) GGSN making A + AAAA requests to get all addresses and making mappings
7) GGSN DNS proxy (??)

5 References

[1] 29.060-620

EXHIBIT B

Attending to this matter
Ingalill Ohlsson Pipidi

Date
2004-03-24
Your Date

Reference
P19221WO/04:1101
Your Reference

Via fax, original by mail
cc: Aarre Kilpinen

Marks & Clerk
Att: Robert Lind
4220 Nash Court
Oxford Business Park South
Oxford OX4 2RU
UNITED KINGDOM

Dear Robert

PCT APPLICATION WITH THE EPO

Our Ref: P19221WO
Slogan: HIP Proxy in the GGSN

SOME SPECIFIC RULES CONCERNING THIS APPLICATION.

Various Ericsson companies participate in joint research projects sponsored from the EU sixth framework program. Participants in such projects have to comply with various rules according to the Project Contract with the Commission and to Consortium Agreements beteween all participants in the project. The rules apply to all inventions "arising from" a FP6 project.

Ericsson has decided on a couple of procedural steps for patent applications and patents considered to fall under the FP6 rules. The procedural steps are mandatory for the whole Ericsson Licensing and Patent Development organisation worldwide. Our inhouse docketing system is a tool for implementing this. In brief and simplified the special procedure steps are as follows.

1. The inventor(s) shall assign all right(s) to the invention to the Ericsson company/companies employing the inventor(s) prior to filing of the priority application.

2. For assigning the invention to an Ericsson company prior to filing a special assignment form shall be used.

3. The priority application on an invention "arising from" a FP6 project shall always be a PCT application.

4. The applicant in the priority application shall - except for USA - be the Ericsson company/companies who was/were the employer(s) of the inventor(s) when the invention was made and consequently also participated in the FP6 project. Accordingly there might sometimes be two or more joint applicants.

5. **Ericsson** sends a special letter to the other participants of the project about 13 months after the priority date.

6. **Ericsson** will inform the IB about 16 months after priority date that the application - except for USA - has been assigned to the parent company of the Ericsson Group, i.e. Telefonaktiebolaget LM Ericsson (publ)

7. National/regional applications based on the PCT application shall be filed in the name of the parent company.

Due to the fact that the letters according to 5 above will be generated by our docketing system, the information to the other participants will be sent *directly from Ericsson, not from the official representative. For the same reason the letter to IB informing on the assignment to Telefonaktiebolaget LM Ericsson will also be sent directly from Ericsson, not from the official representative in the PCT application.*

Please start drafting a PCT application. After approval from the patent engineer of the final draft please file the PCT application, using EPO as ISA, and designating all countries, *including* the USA.

Target date for filing an application: **April 15, 2004**

Applicant:
Applicant: OY LM Ericsson AB (LMF)
FI-02420 Jorvas, Suomi

When drafting the application, it should meet the Ericsson Quality Requirements (EQR) for patent applications as well as the requirements of the Patent Cooperation Treaty.

We also ask you to prepare necessary formal documents for the purpose of the U.S. designation and send them to the Patent Engineer for execution by the inventor(s).

As soon as possible after filing, the application date should be reported via fax or e-mail (*notice of filing*). Application number and date, application as filed (text and figures) should be sent as hard copy as well as on diskette via regular mail (*filing report*).

We will send you copies of our direct correspondence with the IB regarding the transfer to Telefonaktiebolaget LM Ericsson (publ), see point 6 above.

If no countries are elected for the national phase applications under Chapter I of the PCT by the due date we want you to file a Chapter II Demand. Please Note the change of applicant for the Chapter II of the PCT.

We expect you to give your comments and drafts regarding any Written Opinion and file the response with the PCT after approval from the Patent Engineer. We ask you to forward copies of any amendments made during the international phase, the ISR, the published PCT, the IPER and other formal documents as soon as possible upon receipt.

Invoice handling

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Ingalill Ohlsson Pipidi
Patent Assistant